Having your catch and eating
it too

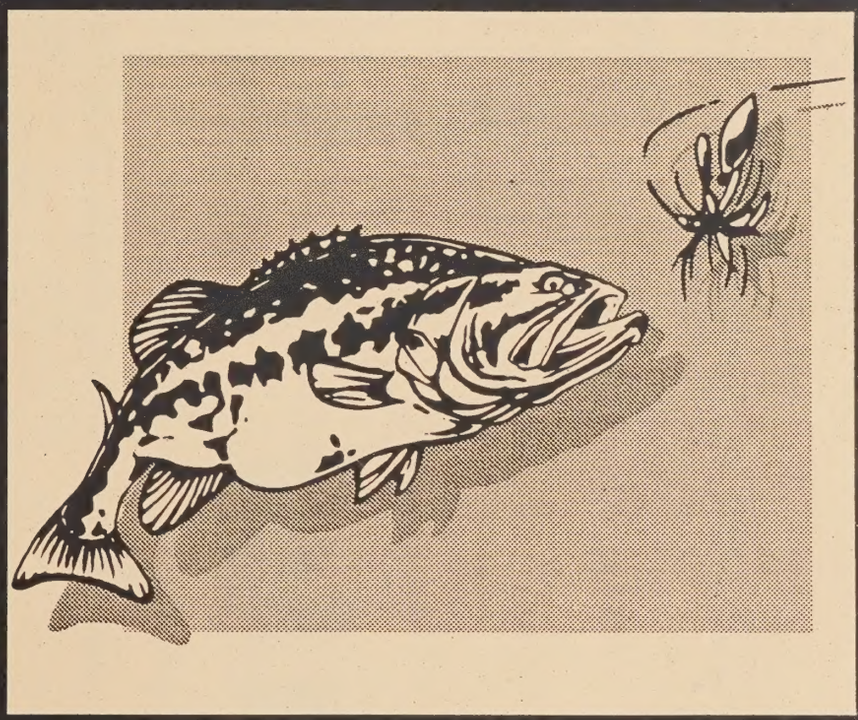
Health and Welfare Canada
Santé et Bien-être social Canada

HAVING YOUR CATCH AND EATING IT TOO

A few words about sport fish and your health

Fishing in the Great Lakes basin is a very popular activity. In 1989, anglers spent more than 845,000 fishing days in Lake Ontario alone. The Great Lakes offer fabulous opportunities for anglers to land many edible species.

Yet, in many parts of the Great Lakes, and numerous inland lakes, people are warned about eating some types of fish. Why? Because some toxic chemicals found in water, even in minute amounts, concentrate in fish. This means we can ingest these contaminants when eating the fish, raising concerns that the levels of toxic chemicals may be harmful to human health. What are these toxic chemicals? And how can we protect our health and still enjoy fresh fillets after a day on the water?



Which chemicals should we be worried about?

In the Great Lakes, toxic chemicals such as PCBs, 'mirex', dioxins and mercury are found in small amounts in the water, plants, fish and wildlife. (For its part, mercury poisoning is also a concern in inland lakes.) Despite the slow rate at which many chemicals breakdown there is good news. Action to clean-up the Great Lakes is having a positive effect. Today, the levels of many contaminants are much lower than they were in the 1970's (see Figure 1 on page 2). However, some chemicals break down very slowly.

Unfortunately, these chemicals are not going to decrease much further because they continue to enter the Great Lakes from contaminated sediments, air pollution falling into the lakes, hazardous waste sites and run-off from contaminated agricultural land. As well, accidental or unregulated industrial pollution also continue to contribute contaminants to the Great Lakes ecosystem.

Persistent Organochlorines

One group of chemicals, organochlorines, are extremely persistent. That is, they do not break down easily in the environment. This group includes industrial chemicals such as PCBs, some pesticides such as DDT and its metabolite DDE, dieldrin, hexachlorobenzene, and mirex, and other chemical byproducts including dioxins. Fish take in and accumulate these pollutants by eating contaminated

Continued on page 3

Great Lakes Health Effects Program
A partner in the Great Lakes Action Plan (Government of Canada)

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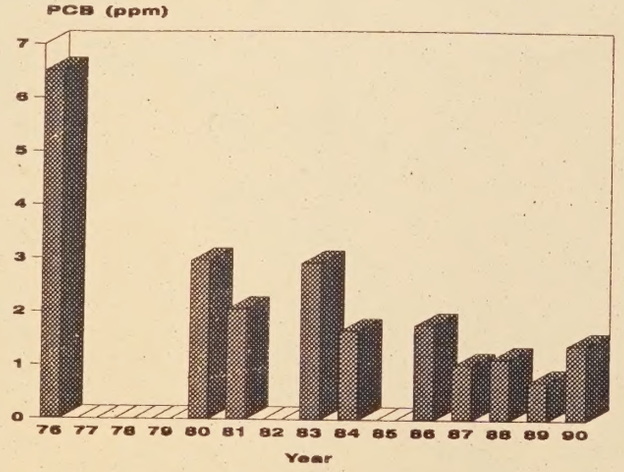
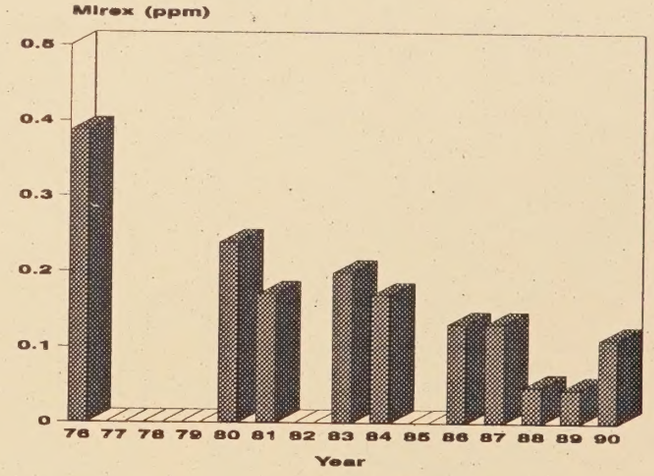
Figure 1

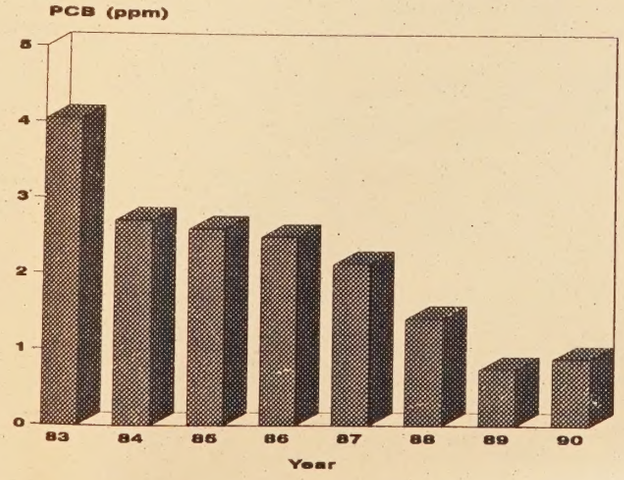
PCB and Mirex Levels Measured in 75 Centimetre Rainbow Trout Caught From Lake Ontario at the Ganaraska River. *

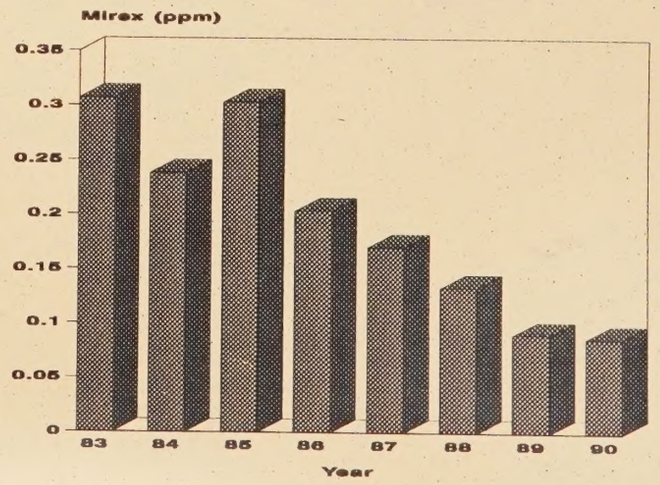




* Note: No data were available for 1977, 1978, 1979, 1982 and 1985.

PCB and Mirex Levels Measured in Chinook Salmon Caught From the Credit River.





Figures courtesy of the Ontario Ministry of the Environment

Continued from page 1

food or sediments, or absorbing them directly from the water through their gills. Consequently, some organochlorines have been found in Great Lakes fish at levels possibly harmful to humans if we eat to much fish.

Unfortunately, many organochlorines are quickly taken in by plants and animals. They are stored in animal organs like the liver or kidney and fatty tissues. This means fattier species of fish and animals tend to have higher levels of these chemicals.

In fish, organochlorines build up in organs and fat over time, meaning older, larger fish are usually the most contaminated. Similarly, shorter lived species like perch are generally less contaminated than longer lived species like salmon.

Some contaminants also settle to the bottom of lakes and rivers and attach to sediments. Bottom-dwelling species that feed in contaminated sediments, such as brown bullhead or white sucker, are likely to accumulate more contaminants.

Contaminant levels in fish are higher than levels in water because of a process known as 'biomagnification'. Tiny organisms, such as invertebrates, living in a contaminated lake, ingest toxic chemicals directly from the water. The invertebrates are eaten by small fish which in turn are eaten by larger fish. When the larger fish eats a smaller fish, it takes in all the contaminants the smaller fish has stored through its lifetime. Therefore, top predator species such as trout, salmon and walleye tend to become more contaminated. This means contaminant levels in fish can be a million times higher than those found in the water in which the fish live.

Mercury and other metals

In some inland lakes and areas of the Great Lakes, anglers are warned about eating their catch because of mercury levels. Unlike the organochlorine chemicals, some mercury comes from the rocks and soil around the lakes. Acid rain may cause the release of higher amounts of mercury in rocks and soil into water, resulting in higher levels of mercury in fish. Mercury can also enter a lake from industrial discharges or air pollution carried long distances.

The inorganic form of mercury found in a thermometer is not easily absorbed by living organisms. However, bacteria in the mud and sediments at the bottom of lakes change the mercury to a more toxic form, called methylmercury. It is easier to absorb and more toxic than inorganic, metallic mercury. Usually 85% of total mercury found in fish is in the form of methylmercury.

How the bacteria change inorganic mercury to methylmercury is poorly understood, but certain environmental conditions appear to increase the rate of methylmercury production. For example, damming rivers to create reservoirs in Northern Manitoba and Quebec has increased the conversion of inorganic mercury to methylmercury, resulting in more mercury in the fish.

Instead of being stored in fat, methylmercury attaches to proteins in fish flesh, accumulates in the liver as inorganic mercury, and builds up over time. Therefore older, predator species are more highly contaminated.

There is no concern about levels of other metals found in Ontario fish such as lead, cadmium, and arsenic.

PAH's (polycyclic aromatic hydrocarbons)

PAH's are receiving more media attention than they used to. Common contaminants of the Great Lakes ecosystem, they are formed from incomplete combustion of fossil fuels, organic matter and garbage. They are also components of many petroleum products including creosote and vehicle exhaust.

As well, PAH's are present in various foods prepared through methods such as smoking, grilling, frying and barbecuing. Current levels in fish are not a health concern to people. However, there are signs that PAH's may be affecting the health of some fish. Species directly exposed to high levels of PAH's in water and sediment, especially brown bullheads and suckers, are thought to develop lip and skin cancers and other tumours.

Figure 2 **Mercury Levels Measured in Walleye Caught From Four Ontario Regions**

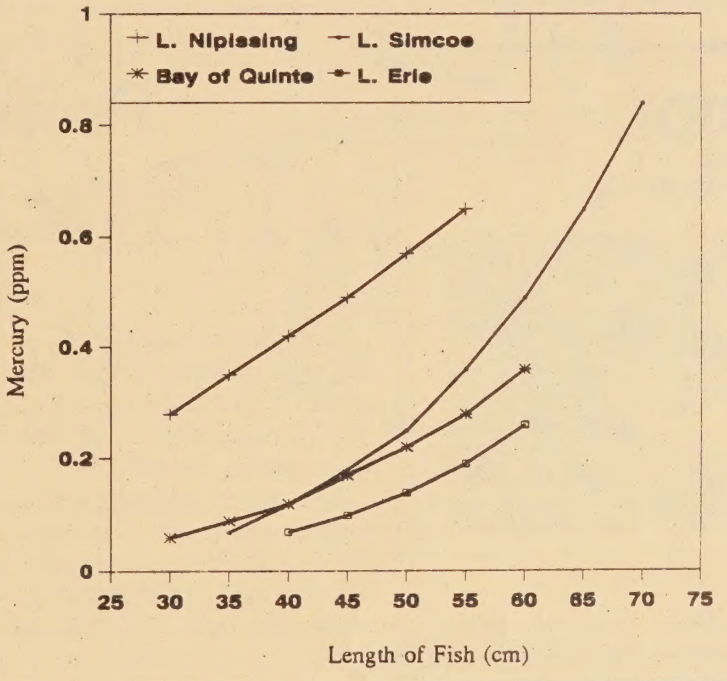


Figure courtesy of the Ontario Ministry of the Environment

Health watch

We know that high doses of some of these chemicals are dangerous. But it is still unclear if eating fish with low levels of contaminants over a long period of time causes harmful effects. In laboratory and wildlife studies, organochlorines have been linked to many health effects, including effects on the immune system, fertility, pregnancy, birth and the development of offspring.

The effects on people are harder to pin down. However, a limited number of studies have indicated that organochlorines may be linked to reproductive, developmental and immune system effects in humans as well.

Organochlorines are stored in body fat and tend to be eliminated very slowly. Therefore, over time, they will concentrate in our bodies. For example, most people today have minute amounts of PCBs in their blood and fatty tissues. People who eat a lot of fish with high PCB levels have higher concentrations of the pollutant in their bodies than the general population.

Mercury is known to affect the human nervous system. At high enough concentrations, mercury can affect your ability to feel, see, taste and move. Unborn babies, children and pregnant women may be more sensitive to mercury.

With time, the body can get rid of mercury, provided that exposure is eliminated. Therefore, harmful levels accumulate in the body only if the person eats contaminated fish frequently and regularly.

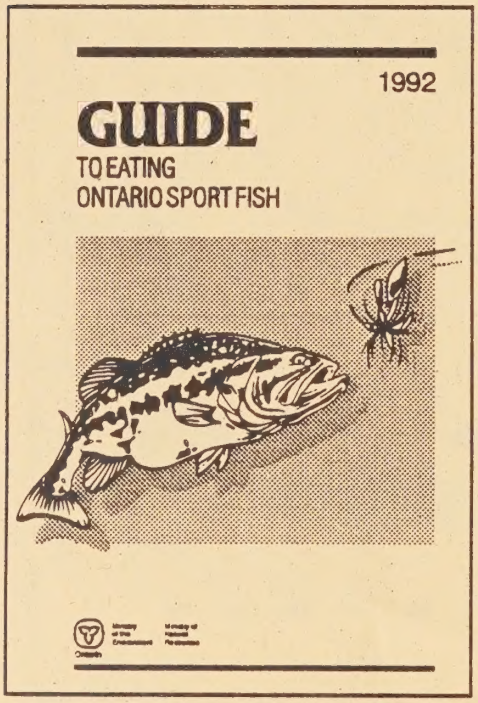
Fish advisories

Because of the health concerns, it is important to follow current fish advisories when eating sport fish. Every year the Ontario Ministry of the Environment publishes the "Guide to Eating Ontario Sport Fish" (See below). The guide contains advice on eating fish from inland lakes in Southern Ontario, Northern Ontario and locations around the Great Lakes .

The advice in the book is prepared using guidelines set by Health and Welfare Canada for a number of contaminants in commercial fish. For example, the guideline for PCBs for the edible portion of fish is 2 parts per million (One part per million is comparable to one ounce in 31 tons). The guidelines are based on the results of laboratory studies and, where possible, studies on humans that assess the effects of PCBs on reproduction, development, cancer and organ function.

Every year, the Ontario Ministry of the Environment tests thousands of fish from many locations throughout Ontario. Samples are taken from skinless, lean dorsal fillets. The results are compared with the health guidelines to determine how much is safe to eat. Guidelines are constantly under review. As new scientific data become available, they are revised to provide maximum safety.

Fish caught and sold commercially are routinely monitored for these contaminants by the federal Department of Fisheries and Oceans before they are offered for sale.



Protecting your health

Usually we can't see, feel or smell any toxic chemicals in fish. The amount of a chemical in a fish can only be determined through laboratory tests of fish samples.

Some anglers feel that if a fish is contaminated, it will have an unusual skin condition or meat texture. A recent survey of 229 Michigan anglers found that 42% of the anglers used the appearance, taste, or smell of the fish or water to determine if the fish were safe to eat. Some even thought safety was a concern if there were a lot of dead fish in the area. Not so! Contaminants can occur in fish at levels unsafe for humans without killing or, visibly harming the fish or changing the taste of the fish.

Here's what you can do

Remember: Fish is a nutritious food that can be eaten safely when you follow a few simple guidelines:

• **Use the "Guide to Eating Ontario Sport Fish".** You can find a copy each spring from many fishing license outlets, fishing and hunting stores, liquor and beer stores or any Ministry of Natural Resources or Ministry of Environment office.

It helps to spend some time reading the introduction to understand how to use the Guide. If you have trouble figuring it out, there is a phone number at the beginning of the Guide to call for more information.

• **Remember that consumption advice in the guide is stricter for children under 15 and women of child-bearing age (pregnant women, women intending to become pregnant or breast-feeding mothers).** These groups should only eat fish from the "unrestricted" category.

• **Size and type of fish are important!**

Shorter, younger fish usually have lower levels of organochlorine contaminants and mercury (see Figure 2 on page 3).

Use the "Guide to Eating Ontario Sport Fish" to decide which size of fish to eat.

Remember, fattier species such as salmon and trout tend to accumulate higher levels of organic contaminants than non-fatty species like walleye, bass or pike (this is not true for mercury).

Choose the prey species and shorter lived species, like perch and bass, which will have lower levels of mercury and organic compounds.

The "Guide to Eating Ontario Sport Fish" can also help you decide which type of fish to eat.

• **Fish preparation makes a difference!**

To reduce organic contaminants, trim and discard:

1) the skin;
2) the fat along the backbone;
3) the fat along the lateral line;
4) any belly fat from the fish (see diagram below).

In a recent study using Lake Ontario brown trout, trimming the fat and belly tissue from the fish reduced fat levels by 62% and PCB levels by 46%.

Because advice in the "Guide to Eating Ontario Sport Fish" is based on laboratory tests of skinless, trimmed fillets, it is important to trim the fillets and use the guide.

The guide also provides tips on preserving and preparing fish for cooking. Fish preparation methods do not affect mercury levels.

• **Use cooking methods that reduce fat content.**

To reduce organic contaminants, use cooking methods that remove the fat, like broiling the fish on a rack. Discard any fatty juices obtained during cooking.

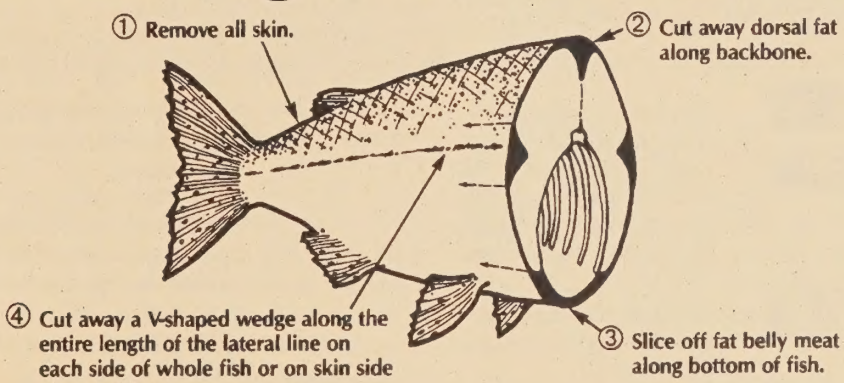
Avoid making fish chowders or soups where the fat is kept in the soup. Cooking methods do not effect mercury levels.

• **Long-term action is best!**

We all have to work together to reduce pollution so that, in the future, all fish will be safe to eat regardless of size, fat content or where they were caught. We can do this!

Get involved in your community.

Cleaning Great Lakes Fish



Some Great Lakes fish are contaminated with low levels of toxic chemicals. You can minimize your intake of these chemicals by properly cleaning, trimming, and skinning your fish. Follow the four steps.

Cooking does not destroy chemicals but the heat from cooking melts the fat in the fish, removing some chemicals. Do not use fish drippings in anything meant to be eaten. Discard fish drippings in the garbage.

Courtesy of the University of Wisconsin Sea Grant Institute (1800 University Ave., Madison, WI 53705)

What else can we do?

We need to learn a lot more about fish consumption and human health. Health and Welfare Canada and other agencies are very involved in studying these issues.

For instance, in 1992 over 1800 anglers in Cornwall and Mississauga helped by filling out a questionnaire on their consumption of fish. Survey results will tell us more about the number and types of fish people are eating from the Great Lakes Basin.

Blood, hair and urine samples provided by volunteers are being tested for contaminants. The information will help us understand the link between consumption of fish and exposure to toxic chemicals. For more information about the study, contact Jill Kearney, Health and Welfare Canada, Environmental Health Centre, Tunney's Pasture, Ottawa, Ontario K1A 0L2. (613) 957-8487

An excellent 15-minute video called "Fishing for Answers" has been prepared by the Sea Grant Institute, Wisconsin.

If you would like a copy to show to a group, contact Sea Grant Institute, Communications, University of Wisconsin-Madison, 1800 University Avenue, Madison, Wisconsin, 53705.

If you are confused about these issues or want more information, write us. We'll try to help.

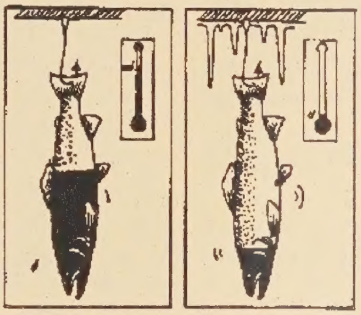
The Great Lakes Health Effects Program
Health and Welfare Canada
Environmental Health Centre
Tunney's Pasture
Ottawa, Ontario
K1A 0L2

FISH TALES

FACT OR FICTION?

The Right Way
"Consult the guidelines in the Guide to Eating Ontario Sport Fish"

There are two ways to limit your mercury intake from eating Ontario sport fish:



The Wrong Way
(Unbelievable!!!)
i) Hang fish by tail in the freezer
ii) When fish freezes, all mercury will go to its head...(???)
iii) Then, cut off head, thereby removing all mercury

Fiction: *If a fish is contaminated it will taste or smell bad.*

Fact: Most contaminants in Ontario fish including PCBs, mercury, mirex and dioxins are odourless and tasteless .

Fiction: *If a fish is contaminated the, organs or flesh will be discoloured.*

Fact: Fish can store contaminants in amounts that will not **kill** them or change their appearance.

However, there may be enough of the chemicals to affect our **health.** Analyzing a fish in a laboratory is the only way to know whether it has harmful levels of a contaminant

The "Guide To Eating Ontario Sport Fish" offers consumption advice based on thousands of laboratory analyses for fishing areas all over Ontario.

Fiction: *Mercury levels go down in the winter, just like in a thermometer.*

Fact: Methylmercury attaches to proteins in the fish and remains there through all seasons, regardless of temperature.

Graphic: Ministry of Environment Water Resources Branch

SOME TOXIC CHEMICALS IN THE GREAT LAKES WATERSHED

PCBs or "polychlorinated biphenyls" are mixtures of 209 similar chemicals widely used in electrical and hydraulic equipment and lubricants because they are chemically stable and heat resistant. They are very slow to break down and are now found everywhere in the environment, including fish and human tissues. Each individual PCB (called a 'congener') has the same general structure as other PCBs but varies in the number of chlorine atoms it possesses. Recent research indicates that the degree of chlorination may affect the level of toxicity. Effects seen in studies with laboratory animals have included decreased longevity, developmental effects in the offspring, reproductive effects, and cancer. Occupational exposure to high levels of mixtures of PCBs has occasionally been associated with skin irritations and liver effects. In 1980, the use of PCBs in Canada was restricted to existing electrical and mechanical equipment; the importation or manufacture of PCB-filled equipment was also prohibited. (PCBs are still manufactured in some countries). As a result of these restrictions, the levels of PCB have declined 10-fold in many fish species in the Great Lakes. The federal guideline for PCBs in fish is 2.0 parts per million (ppm).

DDT (and DDE) was introduced into North America in 1946 as an insecticide. Although DDT is a relatively stable chemical, it is converted to DDE in living organisms and in the environment. DDE stored in animal and human fat was identified as the cause of eggshell thinning in many birds and has been found to disrupt hormones and change the activity of liver enzymes. The use of DDT was restricted in Canada in 1974 and suspended in 1985. In 1989, the last permitted use was banned. The levels of DDT and DDE have decreased significantly although concentrations in fish and wildlife have now levelled off. DDT is sill used elsewhere in the hemisphere and may be entering the Great Lakes through atmospheric transportation and deposition. The federal guideline for DDT plus DDE and other by-products in fish is 5.0 ppm.

Mirex is an extremely persistent insecticide, which slowly breaks down to photomirex. Both mirex and photomirex are toxic. Mirex was used in the southern United States but was never used in the Great Lakes Basin. However, it is present in the Lake Ontario food chain because of industrial pollution from the processing plant in Niagara Falls, New York, and a manufacturing plant in Oswego, New York. Mirex has been found in tissues of people living in the Basin. All uses in Canada and the United States were banned in 1978. In laboratory animals, mirex has caused several effects including liver cancer, toxic effects in the rat fetus and developmental effects in the rat offspring. The federal guideline for mirex in fish is 0.1. ppm.

Dioxins and furans are a group of chemicals which are unwanted by-products of some chemical manufacturing processes and industrial practices (e.g. the manufacture of some pesticides and the bleaching of wood pulp with chlorine). They can also be produced during combustion. As well, they have been detected in exhaust from vehicles using leaded fuels and incinerator emissions. One particular dioxin, known as 2,3,7,8-TCDD is extremely toxic, but the effect varies in different species. Animal laboratory studies of longer term exposures have resulted in damage to the liver , the reproductive system and the immune system, and weight loss.

Accidental exposures of human to 2,3,7,8-TCDD have resulted in skin lesions, but have not been fatal or led to a detectable increase in cancer rates. The Ontario Ministry of the Environment has a program to reduce or eliminate the formation of all dioxins and furans by altering industrial practices. As well, recent federal legislation will reduce the amount of dioxins and furans being emitted from pulp and paper mills. The federal level of dioxins for the edible portion of fish is 20 parts per trillion (ppt) of 2,3,7,8-TCDD. The level is currently under review.

Mercury is found naturally in the environment in its 'inorganic' form, which is not easily absorbed by plants or animals. In the past, inorganic mercury has been widely used in the manufacture of chlorine and caustic soda (chlor-alkali process) and as a slimicide in the pulp and paper industry. Consequently, it has been discharged into the environment. Mercury in the bottom mud of a lake or river is converted into 'methylmercury' by microrganisms. Methylmercury is rapidly absorbed by fish, either through the food chain or directly from water passing over the gills. The human body can eliminate half its total mercury in 70 days.

Methylmercury in known to affect the human nervous system. In the late 1960's highly contaminated shellfish eaten by the residents of Minimata, Japan, resulted in tingling sensations in the fingers, tunnel vision and slurred speech. In Canada, methylmercury has been cited as the possible cause of a neurological disease in some native communities where consumption of large amounts of fish occurs. Since the early 1970's, the amount of mercury released into the environment has decreased substantially.

The reduction has been due to closer regulation of emissions and effluent discharges and improvement of the processes using mercury or its replacement with alternative materials. This has been reflected by declining levels of mercury in fish over the same period. The federal guidelines for mercury in fish is 0.5 ppm.

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10%